# Using Semiotic Grammars for the Rapid Design of Evolving Video Game Mechanics

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**Abstract**

In prior work, we proposed the model of cardboard semiotics. The model applies the use of semiotics (the study of signs and symbols and their interpretations) as a conceptual prototyping tool for game story development. In this paper we adapt the theoretical principle of cardboard semiotics towards an engineered formalism for the design of game mechanics. We first provide a brief introduction to video game literacy, a key method of semiotic analysis, and examples of the new approach by looking at its application in the design of Real-Time Strategy (RTS) and First-Person Shooter (FPS) games. We then use generalized semiotic grammars, or methods for composing symbolic sentences, to expose the underlying frameworks of popular commercial games to show how games can be re-imagined in other contexts through the semiotic technique of structural analysis.

## 1. Objective

In McDaniel et al. [2009], we proposed the concept of cardboard semiotics. This model applies the use of semiotics (the study of signs and symbols and their interpretations) as a tool for the rapid conceptual prototyping of narrative elements, dramatic structure, gameplay events (or choices) and game structure. We explored the concept that, through the use of semiotic concepts and methods, a general framework with generic units may be constructed and that later these generic units can be refined into specific content. We called these units "cardboard" to emphasize the idea that they should be used as "place-holders" in the early phase of game development without investing significant resources in their production. What was missing from this first paper, however, was a fully developed semiotic grammar from the perspective of game mechanics. To continue this line of inquiry, in this paper we expand on the notion of cardboard semiotics by exploring an area of natural application: design of game mechanics.

Gee [2005] maintained that video games exist in multiple semiotic domains due to the distinctive nature of video game genres. He argues that literacy (both the understanding and producing of meaning) must be contextually situated in a semiotic domain. Zagal [2008] expanded Gee's notion of literacy to define 'game literacy' as:

1. Having the ability to play games
2. Having the ability to understand meanings with respect to games
3. Having the ability to make games.

In this paper, we discuss video game mechanics through the lens of game literacy as fueled by semiotic analysis. Along the way, we construct some general semiotic grammars for understanding how "games as symbol systems" are constructed, and how they can be disassembled and reassembled in various creative ways.

## 2. Theoretical Framework

A video game can be described as a collection of game mechanics that lead a player through a critical path of meaningful choices. The game has rules and a quantifiable outcome [Salen & Zimmerman, 2004], both of which are tied directly to the critical path designed by the game's developers. The critical path can be described as a suite of interesting, meaningful choices that a player must make in order to traverse the game space from the start of the game to its quantifiable outcome. Thus, a mechanic can be defined as a piece of play activity that allows a player to make meaningful choices. There are numerous categorizations of game mechanics in sets of high-level descriptors [Fullerton, 2009; Game Board Geek, 2009; Internet Pinball Database, 2009].

What is important to realize, however, is that these high level descriptors are symbols for the more specific mechanics used in the games. We use abstractions of the mechanics rather than the mechanics themselves in an effort to avoid becoming mired in details that are irrelevant to this level of analysis. For example, Turn 10's *Forza Motorsports 3* contains settings in which fuel use and tire consumption impact gameplay. In Bethesda Softworks' *Fallout 3*, players can run out of ammunition. In these two cases, the mechanics appear to be unique, but our claim is that the uniqueness of the mechanics stems only from implementation details. Our method requires just enough abstraction to obscure the details, because doing so helps to expose the root of the play activity embedded in the individual mechanics. In the example mechanics above, the essential nature of each is a) marshalling resources, and b) deciding when to use resources to achieve some goal – two activities we can identify as 'resource management.' These seemingly diverse mechanics become recognizable as


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gameplay equivalences, exposing fundamental similarities between what appeared to be dissimilar games.

Once we have identified these high level descriptions, we can create a clear symbol describing them. For example, we can choose to represent ‘resource management’ with the symbol RM, or any symbol that conveys the appropriate meaning.

Signs, as the basic units of semiotic study, can be understood as the "markers of meaning" [Salen & Zimmerman, 2004] within games as well as in language. Semiotics is a useful tool for game design as it is concerned with the production of meaning through symbolic interpretation. The American semiotician Charles Peirce suggests four key concepts that go along with the notion of a sign [qtd. in Salen & Zimmerman, 2004]:

1. A sign represents something other than itself.
2. Signs are interpreted.
3. Meaning results when a sign is interpreted.
4. Context shapes interpretation.

The contextual, interpretive, and signified nature of signs serves us well as game designers, for we can reuse common symbol sets in various ways without seeming overly banal or derivative. Consider the oft-used “crate” symbol used to hide goodies and its many reimaginings. On a larger scale, we can reuse game themes as well, which are often semiotically arranged to particular genres of mechanics.

To begin, we will first review what may be the best known semiotic method of analysis: structural analysis. Structural analysis involves identifying the atomic units in a system and the functional and structural relationships between them [Chandler, 2002].

A structural analysis of a sentence attempts to clarify its meaning by looking at the differences between words (signs) across the syntagmatic (structural) and paradigmatic (functional) dimensions. In a syntagmatic analysis, we swap the placement of one word with another from the same sentence to examine how the new ordering changes the meaning of the sentence. In this manner, we can analyze the meaning of the original by comparing it to the meaning of the changed ordering, as shown in Figure 1. In a paradigmatic analysis, we examine how the meaning of the sentence changes when we replace a given word in the sentence with another word of the same grammatical type -- not unlike a game of Mad Libs (e.g. a noun for a noun). In Figure 2, we intentionally overuse paradigmatic substitution to illustrate the point and function of paradigmatic relationships.

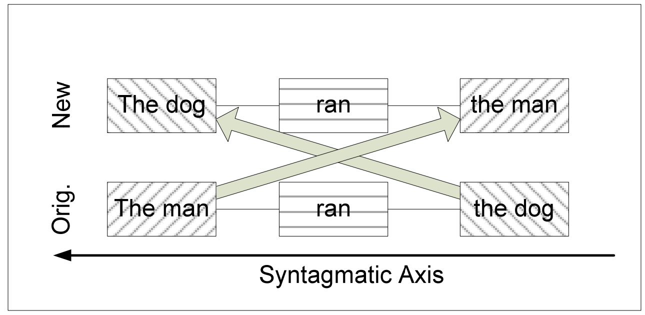


*Figure 1: Syntagmatic Analysis of a Phrase*

By performing both a syntagmatic and paradigmatic analysis of a sentence, we are examining the differences in meaning that accompany the changes we introduce. Chandler [2002] puts it this way: "Syntagms and paradigms provide a structural context in which signs make sense."

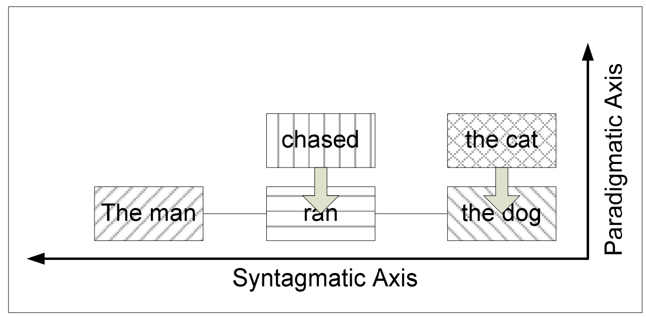


*Figure 2: Paradigmatic Analysis of a Phrase*

Zagal [2008] relates the application of this semiotic method to the study of video games by offering the observation that understanding games relies in part on the deconstruction of games and understanding their components (mechanics, rules, etc). Further, he likens the identification of game components and their relationship to one another with the understanding of the design grammars of semiotic domains (referring to Gee's broadened notion of literacy). As we move forward describing the use of this type of analysis as a game design tool, we will be looking at syntagmatic analysis (structural reordering) and paradigmatic analysis (functional replacement) of semiotic grammar components (game mechanics) to come up with new games. As game designers, we can employ the power of these techniques during the design phase as a generative grammar tool for game mechanics. As in our prior [2009] technique which focused primarily on a method for game and narrative structure, this technique is low cost, easy to deploy, and infinitely configurable within the allowable permutations of the grammatical constraints. Applications of this process are therefore likely to have significant impact on both the generation of novel new game ideas as well as the analysis of, and comparison between, existing games.

## 3. Methods

Novice game designers are frequently stymied by the idea of defining a game solely in terms of game mechanics. For them, the idea that a game mechanic is more important to the success of the game than story or hyper-realistic graphics rendering is difficult to accept. Often this difficulty stems from an inability to see how one game's mechanics can relate to another game in a clear way. Yet, as Zagal [2008] points out, it is often critically important to understand how any given game relates to other games with common mechanics and conventions.

Similarly, it is often difficult for novices to classify their nascent game ideas into a particular genre, or target their ideas for a particular demographic. The cause of this problem also stems from a lack of understanding of the components (in this case, the game mechanics) of the game, as Zagal [2008] points out. Costikyan [2005], defines genre as "a set of game mechanics that together make for engaging play." This notion dovetails nicely with Gee's [2003] concept of design grammars for semiotic domains and the idea that video games are situated in a number of semiotic domains (due to the context created by each genre of game).

With Costikyan's definition in mind, it is clear that a game can be uniquely identified by building a set composed of short descriptors of the game mechanics that create the gameplay. A semiotic grammar can therefore be defined that produces a valid "sentence" of mechanics for that particular game.

For example, we could describe the game of tic-tac-toe in an unordered list of mechanics, like so:

> Place tokens : block opponent : get three in a row : take turns

However, mechanics are not equally important in defining gameplay. Some are essential to successful completion of the game (e.g., core or primary mechanics), and some are merely supportive of success in the game or used to enhance play in other, non-essential ways (e.g., secondary and tertiary mechanics). Ranking mechanics by relative importance to the game provides us with further insight into the game's structure and allows further clarity in differentiating games in the same genre that may contain many of the same abstract mechanics. Using the tic-tac-toe example above, we can reorder by ranking the importance of the mechanics in our "sentence" from left to right as follows:

> Place tokens (core mechanic) : get three in a row (core mechanic) : take turns (secondary mechanic) : block opponent (secondary mechanic)

If we take an additional step and abstract these short descriptors of game mechanics into more generalized descriptions of play, we open the possibility of comparing games described in this manner to each other. To continue the example, we can replace the game-specific descriptions above with these:

> Board control : fulfill victory condition : round-robin turn-based : stop opponent from fulfilling victory condition

This method allows game designers to quickly check that the mechanics of one game are indeed similar to the mechanics of another and are thus suitable targets for competitive analysis. Through the abstraction step, the method may also show novices the overlap between mechanics that otherwise appear to be distinct, allowing them to quickly decide which games are similar and which games are fundamentally different. This might be done by comparing the number of similar high level mechanics in the sentence. Further, we can quickly identify key components of the game by observing a simple rank ordering of mechanics based on relative importance to the game and we begin to see the relationships between both game components in the same game and the mechanics that define two games.

## 4. Evidence

The best way to test the concept of a semiotic grammar is to use it to represent popular mechanics already at work in commercial games. For example, the Ensemble Studios game *Age of Empires* requires a player to create food, gather wood, and mine ore. In another game, *Starcraft*, developed by Blizzard Entertainment, the player must collect minerals and vespene gas. If we attempt to compare these play activities directly, we might be tempted to say that they do not share mechanics, since the activities themselves are different for each game and each mechanic. However, if we generalize all five of these mechanics into 'resource management', we begin to see that the *essential* play activity is, in fact, the same and this allows us to begin mapping the Real-Time Strategy (RTS) genre in a suite of common mechanics. Additional abstract mechanic descriptors for RTS games are included in Table 1 (note that this is an incomplete set).

| **RTS Mechanic** | **Symbol** |
|---|---|
| Resource Management | RM |
| Construction | C |
| Technology (Skill) Tree | TT |
| Unit Management | UM |
| Strategic Combat | SC |
| Map Conquest | MC |

*Table 1: Abstract Mechanic Descriptors for RTS Games*

*BioShock* and *Dead Space*, both First Person Shooters (FPS), also have core game mechanics that can be abstracted to include high level descriptors such as resource management (as with *Fallout 3*), exploration and puzzle-solving, tactical combat, and level control. The games are set in entirely different environments and with at least marginally different storylines.

To consider the symbolic mechanics of many FPS games, we can construct another symbolic mapping similar to that shown in Table 1. These abstract mechanic descriptors for FPS games are summarized in Table 2 (note that this is an incomplete set).

| FPS Mechanic | Symbol |
|---|---|
| Resource Management | RM |
| Exploration | E |
| Puzzle Solving | PS |
| Tactical Combat | TC |
| Level Control | LC |

*Table 2: Abstract Mechanic Descriptors for FPS Games*

This abstraction step allows us to easily map the genre (or play style) of any particular game. We can do this by identifying canonical games from that genre, creating sentences of abstract mechanic descriptions, composing them into a table (as we have begun to do in tables 1 and 2), and analyzing the table for commonalities. In this way, we can at a glance determine that the two genres of RTS and FPS are fundamentally different, despite the fact that both use resource management (although, it is fair to say that each genre utilizes this mechanic in a completely distinct manner). We can apply the same method to individual games just as easily.

For example, we can reduce *Age of Empires* to the sentence shown in Figure 3. In Figure 4, we show the reduced description of *BioShock*. We can immediately see that the games are vastly different based on the symbolic representations of the mechanics, without even knowing what each card represents. (As in our previous examples, the order of importance of these mechanics are displayed left-to-right, with core mechanics first.)

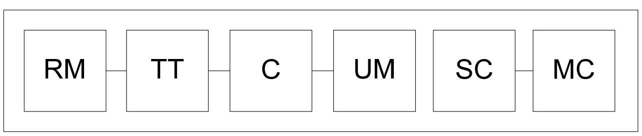


*Figure 3: Mechanic Sentence for Age of Empires*

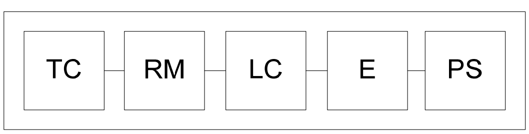


*Figure 4: Mechanic Sentence for BioShock*

## 5. Results

From these examples, two important findings emerge. First, by building a semiotic grammar, we can analyze any game or genre, existing or proposed. Second, we can use these symbolic analyses to help fuel design of novel games.

Say, for instance, that we want to develop a new RTS but don't know where to begin. We can employ any number of brainstorming methods, which may or may not result in an idea for an RTS, or we can take a more targeted approach. For instance, we can start with an abstract description of an *existing* RTS game, say the mechanical sentence provided in Figure 3.

Consider the implications on gameplay of altering this sentence using methods borrowed from structural reduction. If we employ syntagmatic substitution to reorder the priority of the mechanics as shown in Figure 5, the game would be very different from *Age of Empires*. In this case, a syntagmatic substitution changes the priority of the game mechanics, without changing their substances – in effect, the core mechanic of Age of Empires might be retasked as a secondary mechanic for the new game.

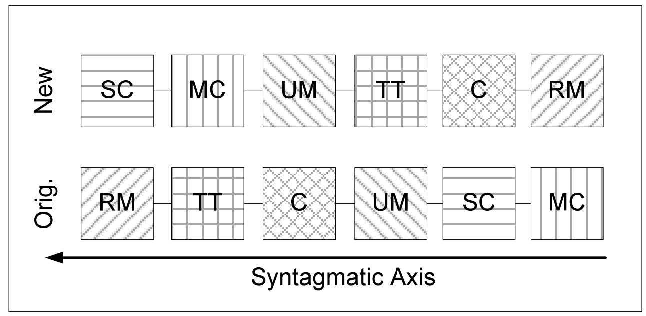


*Figure 5: Mechanic Sentence Altered by Syntagmatic Substitution*

Again borrowing from structural analysis, we can further alter the game via paradigmatic substitution. In this case, such a substitution amounts to replacing one high-level mechanic for another. If we use the altered sentence for our new game as described in Figure 5, but replace the map conquest mechanic with tactical combat, while at the same time replacing the construction mechanic with the level control mechanic (as shown in Figure 6), the resulting game is again quite different from *Age of Empires*.

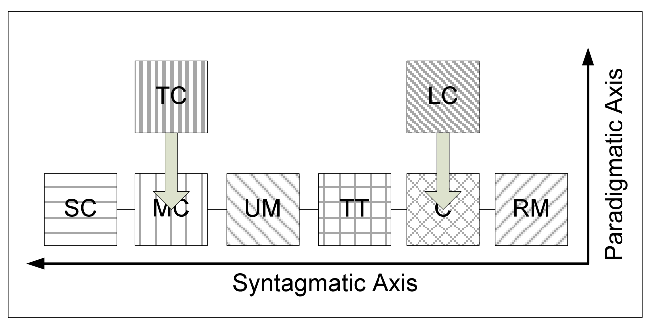


*Figure 6: Mechanic Sentence altered by Paradigmatic Substitution*

We can continue on in this manner for as long as necessary to create a set of interesting mechanics. Further, as we have done in Figure 6, we can mix and match mechanics from other genres and create new play styles at will with little investment or effort.

Hopefully, it is clear that the tokens being manipulated above are generic classifiers for the actual mechanics of the game. The next step for the designer, then, is to begin the expansion of these tokens towards actual game mechanics that will be used in the nascent title.

For example, our produced sentences use two mechanics that go hand-in-hand with actual warfare: strategic combat and tactical combat. Of course, these generic tokens can be defined in many different ways, and so many games use them in ways that do not mirror warfare, and we should not feel constrained to do so either. We might specify strategic combat by emulating political strategy as described by Machiavelli. Further, we may elect to replace tactical combat with diplomatic negotiation tactics. Likewise, we can replace the traditional unit management found in RTS games with management of colony states and a diplomatic corps. We might elect to add political manipulation of the press, intelligence gathering, diplomacy, contract negotiation and international law in the place of our technology tree token. Level control can be replaced with world domination through peaceful propagation of ideology. Finally, resource management might become budget management, production of technology, entertainment, business products, etc., that would be useful in spreading political ideology. When viewed together, these mechanics have a decidedly RTS slant, but with some non-traditional choices. In addition, we've also incorporated mechanics from the FPS genre successfully.

From here, the designer may continue to iterate on these expanded mechanics or might attempt to brainstorm narrative or structural elements for the game design using cardboard semiotics [McDaniel et al., 2009].

## 6. Scholarly Significance of Semiotic Grammars

At a scholarly level, our method bridges the gap between analysis and creation of video games, and provides a formal method for satisfying the criteria of game literacy as proposed by Zagal [2008]. In addition, we describe a method for composing design grammars specific to the multitude of semiotic domains that exist in video game genres [Gee, 2003].

The significance of applying semiotic grammar analysis to the realm of videogames is that it provides a new, powerful tool for game researchers and scholars. Games are often compared to each other and/or described by genre, which provides a high level of taxonomy without providing a clear insight into specifics of gameplay within the game.

At an applied level, using semiotic design grammars, a game designer can begin with a set of high-level, abstract structures that describe game mechanics for a potential game and progress from there towards a low-level, specific collection of mechanics to be used in actual gameplay, much in the same way as we moved from reconfigurable narrative and game event symbols towards actual narrative elements and structural game elements in McDaniel et al. [2009]. This work incorporates an applied theory that can be used by practitioners to create better games by focusing the design work on gameplay and mechanics from the beginning. The prioritized nature of the semiotic grammars will benefit all practitioners by explicitly emphasizing the relationship between game mechanics during conceptualization and allowing appropriate, relative emphasis to be placed on mechanic design.

Certainly, this method would benefit from a ubiquitous taxonomy of high level descriptors of mechanics, implementation level mechanics, and, possibly, mappings between the two sets, that is dynamic and maintained by the community as a whole (e.g. a wiki dedicated to the subject). Perhaps this work will take a fun and interactive form, such as the game-based method described by [Ahn & Dabbish, 2004] for classifying images on the web. This would lay the ground work for future work in this area including movement toward a commonly agreed upon set of game related symbols that would allow for a common ground of semiotic sentences or phrases that would enable scholars to categorize games more clearly. For example, scholars employing this new method in the future might refer to *BioShock* as an FPS within a group of games with a TC:RM:LC:E:PS structure. This would allow for more in-depth categorizations with an opportunity to discern groups of games by structure at a glance.

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